JP-A No. 9-172435
[Title of the Invention]
DISTRIBUTED MANAGEMENT SYSTEM

(57) [Abstract]
[Problem] The present invention relates to a network management system, in which a representative agent conducts the polling in a closed state of each group and notifies the manager only in the case of a state change or a fault, and agents monitor each other while automatically replacing the representative agent, thereby distributing the load and securing the reliability of the network.

[Solving Means] A distributed management system comprises: a manager including a means to divide agents connected to a network into groups and notify the representative agent of the agents, a representative agent and the priority; a means to set the addresses and the priority of the agents of each group in a monitor table while at the same time transmitting the addresses and the priority to the other agents in the group for storage; and the representative agent to transmit a frame to the agents set in the monitor table and in the absence of a response to the frame or upon receipt of a fault notice, notify a fault to the manager.

[Scope of Claim for a Patent]
[Claim 1] A network management system for managing agents connected to a network, characterized by comprising: a manager including a means to divide agents connected to a network into groups and set in a frame and notify the representative agent of the agents, a representative agent and the priority;

a means to set the notified addresses and the priority of the agents of each group in a monitor table and transmit the addresses and the priority to the other agents of the group for storage; and the representative agent to transmit a frame to the agents set in the monitor table and in the absence of a response to the frame or upon receipt of a fault notice from an agent in the frame, notify the fault of the agent to the manager in the frame.

[Claim 2] A network management system for managing agents connected to a network, characterized by comprising: a manager including a means to divide agents connected to a network into groups and set in a frame and notify the representative agent of the agents, a representative agent;

a means to determine, set in a monitor table and transmit the addresses and the priority of the agents of the group set in the frame received to the other agents of the group for storage; and the representative agent to transmit the frame to the other agents set in the

monitor table and, in the absence of a response to the frame or upon receipt of a fault notice from an agent in the frame, notify the fault of the agent to the manager.

[Claim 3] A distributed management system as described in claim 1 or 2, characterized by comprising agents including a means to transmit a frame to an agent of high priority with reference to the monitor table and in the absence of a response, determine the agent of next priority as a representative agent and notify all the other agents in the group and the manager.

[Claim 4] A distributed management system as described in any one of claims 1 to 3, characterized by comprising agents including a means to transmit a frame to an agent of high priority with reference to the monitor table and upon receipt of a response thus far not received reinstating the agent of high priority, notify all the other agents in the group and the manager of the restoration of the agent as a representative agent.

[Claim 5] A distributed management system characterized by comprising agents including a means to receive a frame having an access request set therein from a manager, and in the case where the pass word and the access right in the frame are successfully authenticated, set the data in the frame and transmit the frame addressed to the particular local agent toward the network, the means which receives the frame and in the case where the difference between the received data and a designated data is more than or not more than a predetermined value, notifies a fault to the manager.

[Detailed Description of the Invention]

[0001]

[Technical Field Pertinent to the Invention] The present invention relates to a network management system for managing the agents connected to a network.

[0002]

[Prior Art] In the conventional system having a manager and a plurality of agents connected to a network, a frame is transmitted only by the manager for polling to confirm the survival of each agent and the MIB polling to read the data.

[0003]

[Problem to be solved by the Invention] In the conventional system, a frame is transmitted only by the manager individually for polling to confirm the survival of each agent and the MIB polling to read the data. The problem is posed, therefore, that a vast amount of load is imposed on the network connected to the manager.

[0004]
In order to solve this problem, the object of the present invention is to provide a system, in which each agent has the polling function so that a representative agent makes polling in a closed state of each group, and only in the case of a state change or a fault, notifies the manager, and in which the agents monitor each other and the representative agent is automatically replaced, thereby distributing the load while at the same time securing the reliability of the network.

[0005]
[Means for Solving the Invention] A means to solve the problem is explained with reference to Fig. 1. In Fig. 1, a manager 2 monitors a plurality of agents 5 connected to a network, and in this case, is configured of a monitor information setting means 3 and an agent management table 4.

[0006]
The monitor information setting means 3 detects the agents 5 connected to the network and registers them in the agent management table 4, divides the registered agents 5 into groups and determines a representative agent from the agents in each group.

[0007]
The agent management table 4 registers the information on the agents 5 connected to the network and to be monitored. The agents 5 are (terminals) monitored by the manager 2 connected to the network, and in this case, configured of a polling means 6, an agent management table 4 and a monitor table 7.

[0008]
The polling means 6 monitors the agents by polling the frame. The monitor table 7 registers the agents to be monitored, the priority and the monitor time interval T.

[0009]
Next, the operation is explained. The monitor information setting means 3 of the manager 2 divides the agents connected to the network into groups, sets the specific agents, a representative agent and the priority of the agents of each group in a frame, transmits the frame to the representative agent, sets in a monitor table 7 the addresses and the priority of the agents of the group set in the frame received by the representative agent 5, transmits the particular addresses and the priority to and causes them to be stored by the other agents 5 in the group, transmits the frame to the agents set in the monitor table 7, and in the

absence of a response or upon receipt of a fault notice in the frame from an agent 5, notifies the fault of the agent 5 to the manager 2 in the frame.

[0010]
On the other hand, the monitor information setting means 3 of the manager 2 divides the agents 5 connected to the network into groups, sets the specific agents 5 and a representative agent of each group in a frame, transmits the frame to the representative agent, sets in a monitor table 7 the addresses and the determined priority of the agents 5 of the group set in the frame received by the representative agent 5, transmits the particular addresses and the priority to and causes them to be stored by the other agents 5 in the group, transmits the frame to the agents 5 set in the monitor table 7, and in the absence of a response or upon receipt of a fault notice in the frame from a given agent 5, notifies the fault of the agent 5 to the manager 2 in the frame.

[0011]
In the process, the agents 5 transmit a frame to an agent 5 of high priority, by reference to the monitor table 7, and in the absence of a response, determines an agent of the next high priority as a representative agent and notifies all the other agents 5 of the group and the manager 2.

[0012]
Also, the agents 5 transmit a frame to an agent 5 of high priority by reference to the monitor table 7, and upon receipt of a response thus far not received reinstating the agent of high priority, notifies all the other agents 5 of the group and the manger 2 that the agent 5 of high priority is reinstated as a representative agent.

[0013]
Also, an agent 5 receives a frame with an access request set therein from the manager 2. In the case where the pass word and the access right in the frame are successfully authenticated, the agent 5 sets the data in the frame and transmits it toward the network addressed to the particular local agent and receives, and in the case where the difference between the received data and a designated data is more than or not more than a predetermined value, notifies a fault to the manager 2.

[0014]
In this way, the polling function is assigned to each agents 5, which conducts the polling, and only in the case of a state change or a fault, notifies the manager 2 thereby making it possible to distribute the load of the network.

[0015]
[Mode for Carrying Out the Invention] Next, embodiments and operation of the present invention will be explained in detail sequentially with reference to Figs. 1 to 11.

[0016]
Fig. 1 shows a system configuration of the invention. Groups 1, 2, 3 defined by dotted lines indicate the range of arbitrary groups determined in advance. In this case, assume that the ranges are determined as follows.

[0017]

* Group 1: manager #00
* Group 2: agent #11
  agent #12
  agent #13
* Group 3: agent #21
  agent #22
  agent #23

Next, an explanation is given about a detailed procedure in which the manager 2, in accordance with the sequence shown in the flowchart of Fig. 2, detects, by broadcast, the addresses of all the agents 5 connected with a network and set them in an agent management table 4.

[0018]
Fig. 2 is a flowchart (part 1) for setting according to the invention. In Fig. 2, step S1 prepares a frame (Echo). This frame, like the frame (Echo) shown in Fig. 5(a) described later, has set therein the destination address (ff: indicating "broadcast"), the transmitter address (#00: address of manager 2) and the control data (Echo: response request data).

[0019]
Step S2 transmits the frame by broadcast. In the process, the broadcast frame (Echo) prepared at step S1 is transmitted to the network. At step S3, the agents receive the frame (Echo). This means that the agent 5 receives the frame (Echo) transmitted to the network at Step S2.

[0020]
Step S4 determines whether a response is required or not. In the case where the answer is YES, the process proceeds to step S5. In the case where the answer is NO, on the other

hand, it is determined that a local agent is not required to transmit a response, and therefore the received frame is ignored (discarded).

[0021]
In the case where it is determined at step S4 that a response is required, step S5 prepares a frame (EchoReply). This frame, like the frame (EchoReply) shown in Fig. 5(b) described later, has set therein the destination address (#00: address of manager 2), the transmitter address (#11: address of agent 5) and the control data (EchoReply: response data).

[0022]
Step S6 transmits the frame (EchoReply) prepared at step S5 to the network. At step S7, the frame (EchoReply) transmitted at step S7 is received by the manager 2 to which it is addressed.

[0023]
Step S8 makes the registration in the management table. Specifically, the address of the agent and the presence of the response to the frame (Echo) retrieved from the frame (EchoReply) received are registered in the agent management table 4 shown in Fig. 1 (see Fig. 6).

[0024]
Through steps S1 to S8 described above, the manager 2 thus broadcasts the frame and, by means of the response frames from the agents 5 connected to the network, can retrieve and register the presence of the frame (Echo) and the addresses of all the agents 5 to be monitored, as shown in the agent management table 4 in Fig. 6.

[0025]
Step S9 prepares a frame (SNMP request). This frame, like the frame (SNMP request) shown in Fig. 5(c) described later, has set therein the destination address (#11: address of agent 5), the transmitter address (#00: address of manager 2) and the protocol data (GetRequestPDU: PDU request data).

[0026]
Step S10 transmits the frame thus prepared. In the process, the frame (SNMP request) prepared at step S9 is transmitted to the network. At step S11, an agent receives the frame. In other words, the frame (SNMP request) transmitted to the network at step S10 is received by the destination agent 5.

[0027]
Step S12 determines whether a response is required or not. In the case where the answer is YES, the process proceeds to step S13. In the case of NO, on the other hand, it is determined that the particular local agent requires no response, and therefore the received frame is ignored (discarded).

[0028]
In the case where it is determined at step S12 that a response is required, step S13 prepares a frame (SNMP response). Specifically, like the frame (SNMP response) shown in Fig. 5(d) described later, a frame having set therein the destination address (#00: address of manager 2), the transmitter address (#11: address of agent 5) and the protocol data (GetResponsePDU: PDU response data) is prepared.

[0029]
Step S14 transmits this frame. In the process, the frame (SNMP response) prepared at step S13 is transmitted to the network. At step S15, the frame (SNMP response) transmitted at step S14 is received by the destination manager 2.

[0030]
Step S16 makes registration in the management table. Specifically, the address of the agent 5 and the PDU (protocol data unit) retrieved from the received frame (SNMP response) are registered in the agent management table 4 shown in Fig. 1.

[0031]
Step S17 completes the recognition of the agent. In this way, at steps S9 to S17, the manager 2 transmits the frame to the agent 5 to be monitored, receives and registers the response of the PDU data, and completes the recognition of the agent 5 connected to the network to be monitored. The operation is continued as shown in Figs. 3 and 4 following (A).

[0032]
Fig. 3 is a flowchart showing the process in which the manager determines the priority according to the invention. Specifically, the manager 2 determines the priority of the agents in each group, and notifies the representative agent for setting.

[0033]
In Fig. 3, step S21 divides the agents 5 into groups. Specifically, the agents 5 are divided into, for example, group 2 and group 3 as shown in Fig. 1. Step S22 determines a

representative agent of each group. For example, the agent #13 is determined as a representative agent of group 2 shown in Fig. 1.

[0034]
Step 23 determines replacement agents for each group. For example, the replacement agent for the representative agent #13 of group 2 shown in Fig. 1 are determined as #12 and #11.

[0035]
Step S24 prepares a frame (agent). In the process, the frame (agent) in Fig. 5(e), for example, is prepared as follows.

[0036]

* Destination address: representative agent #13
* Transmitter address: manager #00
* Agent data: Representative agent #13
  Replacement agent #12
  Priority: #13, #12, #11
  Monitor time interval: T1

Step S25 transmits the frame.

[0037]
At step S26, the representative agent receives the frame. Step S27 stores the frame in the monitor table. In the process, the data is retrieved from the received frame at step S26 and stored in the following manner in the monitor table 7 shown in Fig. 7.

[0038]

Agent	Priority	Monitor time interval
#13	1	T1
#12	2	T1
#11	3	T1

At step S28, the representative agent transmits the frame to the replacement agents. In the process, the contents of the monitor table 7 set at step S27 are transmitted to the replacement agents (all the agents other than the representative agent).

[0039]
At step S29, the replacement agents store the frame in the monitor table. In this way, the manager 2, dividing the agents connected to the network into groups, determines the

representative agent, the priority and the monitor time interval for each group and transmits the information to the representative agent of the particular group. Each representative agent receives, stores it in the monitor table 7 thereof. At the same time, the representative agent transmits the same information to all the other replacement agents and cause them to be stored in the respective monitor tables 7 thereof. As a result, all the agents for each group share the same monitor table 7, and in the case where the representative agent ceases to operate as described later, a replacement agent takes over the job of the representative agent. Also, at the time of a fault, the representative agent receives the fault information within the whole group and collectively transmits them to the manager 2, thereby making it possible to reduce the load between the networks on the one hand and the load on the part of the manager 2 on the other.

[0040]
Fig. 4 is a flowchart showing the process in which the representative agent determines the priority according to the invention. In this flowchart, the representative agent who has received the notice from the manager 2 determines and sets the priority of the agents in the group.

[0041]
In Fig. 4, step S31 divides the agents into groups. For example, as shown in Fig. 1, the agents 5 are divided into group 2 and group 3. Step S32 determines the representative agent for each group. For example, the representative agent for group 2 in Fig. 1 is determined as #13.

[0042]
Step S33 prepares a frame (agent). In the process, for example, the following frame (agent) is prepared.
* Destination address: Representative agent #13
* Transmitter address: Manager #00
* Agent data: Representative agent #13
Step S34 transmits the frame to the network.

[0043]
At step S35, the representative agent receives the frame. At step S36, the representative agent determines replacement agents and the priority. In the process, for example, the replacement agents are determined as agents #12 and #11, and the priority and the monitor interval time as follows.

[0044]

Agent	Priority	Monitor time interval
#13	1	T1
#12	2	T1
#11	3	T1

Step S37 stores the data in the monitor table. In the process, based on the priority determined at step S36, the data is stored as follows in the monitor table 7 shown in Fig. 7.

[0045]

Agent	Priority	Monitor time interval
#13	1	T1
#12	2	T1
#11	3	T1

At step S38, the representative agent transmits the data to the replacement agents. In the process, the contents of the monitor table 7 set at step S37 are transmitted to the replacement agents (all the agents other than the representative agent).

[0046]

At step S39, each replacement agent stores the data in the monitor table. In this way, the manager 2 divides all the agents connected to the network into groups and notifies the representative agent of each group, while each representative agent determines and stores the replacement agents, the priority and the monitor time interval for the group, while transmitting the information to the other agents in the group and causing them to be stored in the monitor table 7. As a result, all the agents of each group share the same monitor table 7, and in the case where the representative agent ceases to function as described later, the representative agents work in its place, or at the time of a fault, the representative agent receives the fault information in the group and collectively transmits them to the manager 2. In this way, both the load between the networks and the load on the manager 2 can be reduced.

[0047]

Fig. 5 shows examples (part 1) of the frame according to the invention. Fig. 5(a) shows an example of the frame (Echo). This is an example of the frame prepared at step S1 in Fig. 2 described above, and the following items as shown are set therein.

[0048]

* Destination address: ff (indicates "broadcast")
* Transmitter address: #00 (indicates the manager address)

* Control data: Echo (indicates the response request data)

Fig. 5(b) shows an example of the frame (EchoReply). This is an example of the frame prepared at step S5 shown in Fig. 2 as described above, and the following items as shown are set therein.

[0049]

* Destination address: #00 (indicates the manager 2 address)
* Transmitter address: #11 (indicates the agent address)
* Control data: EchoReply (indicates the response data)

Fig. 5(c) shows an example of the frame (SNMP request). This is an example of the frame prepared at step S9 shown in Fig. 2 as described above, and the following items as shown are set therein.

[0050]

* Destination address: #11 (indicates the agent address)
* Transmitter address: #00 (indicates the manager address)
* Protocol data: GetRequestPDU (indicates the PDU request data)

Fig. 5(d) shows an example of the frame (SNMP response). This is an example of the frame prepared at step S13 shown in Fig. 2 as described above, and the following items as shown are set therein.

[0051]

* Destination address: #00 (indicates the manager address)
* Transmitter address: #11 (indicates the agent address)
* Protocol data: GetResponsePDU (indicates the PDU response data)

Fig. 5(e) shows an example of the frame (agent). This is an example of the frame prepared at step S24 shown in Fig. 3 as described above, and the following items as shown are set therein.

[0052]

* Destination address: #13 (indicates the address of the representative agent of group 2)
* Transmitter address: #00 (indicates the manager address)
* Agent data: Representative agent: #13
  Replacement agents: #12 and so forth
  Priority: #13, #12 and so forth
  Monitor time interval: T1

Fig. 6 shows an example of the agent management table according to the invention. This agent management table 4 is set in the manager 2 and all or the required parts thereof in

each agent. The following items as shown in the drawing are registered and managed in this table.

[0053]

* Agent address: #11
* Presence or absence of frame (Echo) response: Present
* Presence or absence of frame (SNMP) response: Present
* MIB community name: A
* Access right: read

where MIB community name sets the pass word (MIB community name) and the access right (only referring to is permitted for "read" and both referring to and updating are permitted for "read/write") exercised by the manager 2 to access the data of the representative agent or the like. For example, the agent #11 is validated only by the access request with a frame in which the manager 2 sets the MIB community name "A" and "read". The agent #11 then sets predetermined data (MIB data) in the frame, which is returned to and can be read by the manager 2.

[0054]

Fig. 7 shows an example of the monitor table according to the invention. This monitor table 7 having the same contents is shared by all the agents 5 in the same group, and sets the priority and the monitor time interval for the agents in the group. For example, the data are set in the following manner as shown.

[0055]

Agent	Priority	Monitor time interval
#13	1	T1
#12	2	T1

where the agent with the priority "1" is the representative agent. The agents having the priority "2" or lower are the replacement agents, which work on behalf of the representative agent in the case where the representative agent ceases to operate (described later with reference to Figs. 8 and 9).

[0056]

Next, in accordance with the sequence shown in the flowchart of Fig. 8, the replacement of the representative agent upon receipt of a frame is explained in detail. Fig. 8 is a flowchart for the replacing process upon receipt of a frame according to the invention.

[0057]

In Fig. 8, step S41 determines whether a predetermined time has elapsed or not. In the case where the answer is YES, the process proceeds to step S42. In the case where the answer is NO, on the other hand, the process stands by. At step S42, the representative agent prepares the frame (Echo) addressed to each agent and transmits it to the replacement agents. In the process, the representative agent transmits the frame (Echo) shown in Fig. 5(a) in which the address of each replacement agent is set as a destination address.

[0058]
Step S43 determines whether the replacement agent has received the frame within a predetermined time. In the case where the answer is YES, the process proceeds to step S44. In the case where the answer is NO, on the other hand, it is determined that the replacement agent has ceased to operate. Therefore, the representative agent is switched to the replacement agent at step S60, and the management table is updated and transmitted to the other member agents in the group (described later) at step S61.

[0059]
In the case where it is determined at step S43 that the frame (Echo) is received within a predetermined time, it is determined at step S44 whether a response is required or not. In the case where the answer is YES, the process proceeds to step S45. In the case where the answer is NO, on the other hand, it is determined that the response is not required and therefore the received frame is ignored (discarded).

[0060]
Step S45 prepares and transmits the frame (EchoReply). In the process, the following items are set in the frame (EchoReply) shown in Fig. 5(b) and transmitted.
* Destination address: address #13 of representative agent
* Transmitter address: address #12 of replacement agent
* Control data: EchoReply: response data

[0061]
Step S46 determines whether the representative agent has received the frame (EchoReply) within a predetermined or not. In the case where the answer is YES, the process proceeds to step S47. In the case where the answer is NO, on the other hand, the process proceeds to step S56 where the information on the absence of response (fault occurrence) from the replacement agent is stored and notified to the manager 2 (described later).

[0062]

In the case where the answer is YES at step S46 and it is determined that the frame is received within a predetermined time, the frame (SNMP request) is prepared and transmitted to each agent at step S47. In the process, the following items are set in the frame (SNMP request) of Fig. 5(c) and transmitted.

* Destination address: address #12 of replacement agent
* Transmitter address: address #13 of representative agent
* Protocol data: GetRequestPDU: PDU request data.

[0063]

Step S48 determines whether the replacement agent has received the frame within a predetermined time or not. In the case where the answer is YES, the process proceeds to step S49. In the case where the answer is NO, on the other hand, it is determined that the representative agent has ceased to operate. Therefore, at step S60, the representative agent is switched to the replacement agent, and the management table is updated and transmitted to the other member agents in the group at step S61 (described later).

[0064]

In the case where it is determined at step S48 that the frame (SNMP request) is received within a predetermined time, step S49 determines whether a response is required or not. In the case where the answer is YES, the process proceeds to step S50, while in the case where the answer is NO, it is determined that the response is not required and therefore the received frame is ignored (discarded).

[0065]

Step S50 prepares and transmits the frame (SNMP response). In the process, the following items are set in the frame (SNMP response) shown in Fig. 5(d) and transmitted.

* Destination address: address #13 of representative agent
* Transmitter address: address #12 of replacement agent
* Protocol data: GetResponsePDU: PDU response data.

[0066]

Step S51 determines whether the representative agent has received the frame (SNMP response) within a predetermined time or not. In the case where the answer is YES, step S52 recognizes the state as normal, and the process proceeds to step S53. In the case where the answer is NO, on the other hand, the process proceeds to step S57 where the information on the absence of response (fault occurrence) from the replacement agent is stored and notified to the manager 2 (described later).

[0067]
At step S53, the agent management table is transmitted to the replacement agent. Step S54 receives and stores the agent management table transmitted at step S53.

[0068]
As described above, in the case where the answer is NO at step S51, the SNMP response is changed to "absence" in the agent management table at step S57 (Fig. 6) and the manager is notified at step S58. In response to this, at step S55, a frame is set, transmitted to and received, retrieved, and displayed by the manager 2 as a message (to notify the replacement agent of a fault, for example) on the screen, while at the same time sampling the log at step S55.

[0069]
In the case where the answer at step S43 or S48 is NO and it is determined that the frame is not received within a predetermined time, step S60 determines that the representative agent fails to work (at fault) and switches the representative agent to the replacement agent of the next priority.

[0070]
Step S61 updates the agent management table, and transmits it to the other member agents in the group and cause it to be updated. In this way, the representative agent transmits the frame to all the replacement agents in the group at intervals of a predetermined time. In the case where a replacement agent fails to receive the frame within a predetermined time, the representative agent is switched to the replacement agent of next priority in the monitor table 7. At the same time, the fault of the operation (specifically, no response of the frame (Echo) or no response of the frame (SNMP)) of the representative agent is set in the agent management table 4 and notified to the other agents in the group. Subsequently, a fault which may occur is notified to the new representative agent similarly, so that the new representative agent can notify the manager 2 of a fault occurrence of the replacement agents. Also, in the case where the representative agent fails to receive the frame from a replacement agent within a predetermined time, the fault of the operation (specifically, no response of the frame (Echo) or no response of the frame (SNMP)) of the particular replacement agent is set in the agent management table 4 and notified to the other agents in the group, while at the same time making it possible to notifying the fault of the replacement agent to the manager 2. As a result, the representative agent and the replacement agents can monitor each other.

[0071]

Next, the replacing process by polling is explained in detail in accordance with the sequence shown in the flowchart of Fig. 9. Fig. 9 is a flowchart showing the replacing process by polling according to the invention.

[0072]
In Fig. 9, step S71 determines whether the replacement agent has passed a predetermined time or not. In the case where the answer is YES, the process proceeds to step S72. In the case where the answer is NO, on the other hand, the process stands by. Step S72 prepares the frame (SNMP request) addressed to each agent (Fig. 5(c)).

[0073]
Step S73 transmits the frame to the agent higher in priority than the local agent. At step S74, the frame transmitted at step S73 is received by the representative agent higher in priority.

[0074]
Step S75 prepares the frame (SNMP response) (Fig. 5(d)). Step S76 transmits the frame. Step S77 determines whether the frame is received within a predetermined time from transmission at Step S73. In the case where the answer is YES, step S78 determines the restoration or not. In the case where the answer is YES, the process proceeds to step S79, while in the case where the answer is NO, the received frame is ignored (discarded). In the case where the answer at step S77 is NO, on the other hand, it indicates that no response of the frame is received from the representative agent. Therefore, the representative agent is switched to the replacement agent of the next priority at step S84, and the process proceeds to step S79.

[0075]
Step S79 updates the agent management table. In the process, in the case where the answer at step S78 is YES, the restoration of the representative agent is determined, and therefore the operation is updated in such a manner that the representative agent in the agent management table is set in operation (specifically, the presence of response of the frame (Echo) or the presence of response of the frame (SNMP)), or in the case where the answer at step S77 is YES, it is determined that the represent agent has ceased to operate (run out of order) and therefore the particular representative agent in the agent management table is set out of operation (specifically, the absence of response of the frame (Echo) or the absence of response of the frame (SNMP)).

[0076]

Step S80 transmits the frame to the other member agents and sets the same contents of the agent management table 4 for all the agents 5 in the group. In the case where the answer is YES step S78 determining the restoration of the representative agent, the current representative agent is returned again as a replacement agent at step S81.

[0077]
At step S82, the representative agent receives the contents of the agent management table transmitted at step S80. In the case where the answer is YES at step S78 and it is determined that the representative agent is restored, step S83 reinstates the restored representative agent in response to the return of the current representative agent to the replacement agent.

[0078]
In the manner described above, the replacement agent transmits the frame to the agent of high priority at a predetermined time interval, and in the case where it fails to receive the response frame within a predetermined time, the replacement agent is switched to the representative agent. At the same time, the fact is set in the agent management table 4 and transmitted to notify all the member agents in the group. The new representative agent thus switched monitors the replacement agents, and upon detection of a fault or receipt of a fault notice, notifies the manager 2. This process of automatic switching of the representative agent is made possible. Also, in the case where the representative agent is restored, the current representative agent is returns as an original replacement agent, while the original representative agent is reinstated.

[0079]
Next, the replacing process by MIB polling is explained in detail with reference to the sequence shown in the flowchart of Fig. 10. Fig. 10 shows a MIB polling flowchart according to the invention.

[0080]
In Fig. 10, step S91 prepares the frame (polling). In the process, as shown in Fig. 11(a) described later, the frame (polling) in which the following items are set is prepared.

[0081]
* Destination address: agent address #13
* Transmitter address: manager address #00
* Trap data: MIB name ("total number of transmission data", for example)
Polling interval

Threshold

Trap type

Step S92 transmits the frame.

[0082]

At step S93, the agent receives the frame. Step S94 determines whether the frame received at step S93 has passed the polling interval or not. In the case where the answer is YES, step S95 prepares the frame (MIB request). In the process, as shown in Fig. 11(b) described later, the frame (MIB request) in which the following items are set is prepared.

[0083]

* Destination address: agent address #13 (address of local agent)
* Transmitter address: manager address #00
* MIB data: MIB community name

Access right

MIB name

Step S96 transmits the frame.

[0084]

Step S97 receives the frame in the same node (in the node of the same agent). Step S98 prepares the frame (MIB response). In the process, as shown in Fig. 11(c) described later, the frame (MIB response) in which the following items are set is prepared.

[0085]

* Destination address: manager address #00
* Transmitter address: agent address #13
* MIB data: MIB response data

Step S99 transmits the frame.

[0086]

Step S100 receives the frame. Step S101 determines whether the MIB value (MIB data) received at step S100 is larger than a predetermined threshold or not. In the case where the answer is YES, a fault is determined, and the process proceeds to step S102, while in the case of NO, the process is returned to step S94 and repeated.

[0087]

Step S012 prepares the frame (trap). In the process, as shown in Fig. 11(d) described

later, the frame (trap) in which the following items are set is prepared.

* Destination address: manager address #00
* Transmitter address: agent address #13
* Trap data: trap community name

Trap type

("the total number of transmission data has exceeded a threshold", for example)

Step S103 transmits the frame.

[0088]

At step S104, the manager receives the frame. At step S105, the contents set in the frame received at step S104 are displayed as a message on the screen.

[0089]

Step S106 samples the log. In this way, the manager 2 transmits the frame (polling) to the agent 5, and based on this, the agent 5 prepares the frame, which is transmitted and received in the same node. In the case where the resultant MIB value exceeds a threshold, for example, the frame (trap) is prepared and the contents of the fault are notified to the manager 2. Thus, the contents of the fault can be displayed as a message on the screen and the log can be sampled.

[0090]

Fig. 11 shows an example (part 2) of the frame according to the invention. Fig. 11(a) shows an example of the frame (polling). This is an example of the frame prepared at step S91 in Fig. 10 described above, and the following items are set therein.

[0091]

* Destination address: agent address #13
* Transmitter address: manager address #00
* Trap data: MIB name ("total number of transmission data, for example)

Polling interval

Threshold

Trap type

Fig. 11(b) shows an example of the frame (MIB request). This is an example of the frame prepared at step S95 in Fig. 10 described above, and the following items are set in it.

[0092]

* Destination address: agent address #13
* Transmitter address: manager address #00

* MIB data: MIB community name (corresponding to the password)
Access right (such as "read" (access))
MIB name (such as the data name to be accessed)

Fig. 11(c) shows an example of the frame (MIB response). This is an example of the frame prepared at step S98 in Fig. 10 described above, and the following items are set therein.

[0093]

* Destination address: manager address #00
* Transmitter address: agent address #13
* MIB data: MIB response data

Fig. 11(d) shows an example of the frame (trap). This is an example of the frame prepared at step S102 in Fig. 10 described above and the following items are set therein.

[0094]

* Destination address: manager address #00
* Transmitter address: agent address #13
* Trap data: Trap community name
Trap type
(for example, "total number of transmission data has exceeded the threshold")

[0095]

[Effects of the Invention] As explained above, according to the invention, the agents 5 have and execute the polling function, and the manager 2 is informed only at the time of a state change or a fault. Therefore, the network load can be distributed.

[Brief Description of Drawings]

[Fig. 1] A system configuration according to the present invention.
[Fig. 2] A setting flowchart (part 1) according to the invention.
[Fig. 3] A flowchart for determining the priority by the manager according to the invention.
[Fig. 4] A flowchart for determining the priority by the representative agent according to the invention.
[Fig. 5] An example of the frame (part 1) according to the invention.
[Fig. 6] An example of the agent management table according to the invention.
[Fig. 7] An example of the monitor table according to the invention.
[Fig. 8] A replacing process flowchart due to frame receipt according to the invention.
[Fig. 9] A replacing process flowchart due to polling according to the invention.

[Fig. 10] A MIB polling flowchart according to the invention.
[Fig. 11] An example of frame (part 2) according to the invention.

[Description of Reference Numerals]
2: Manager
3: Monitor information setting means
4: Agent management table
5: Agent
6: Polling means
7: Monitor table

[Fig. 1]

1 System configuration according to the invention
2 Manager (1)
3 Group 1 (network 1)
4 Agent management table
5 Agent
6 Monitor information setting means
7 Network
8 Polling means
9 Agent
10 Monitor table
11 #21 network
12 Network
13 Agent #12
14 Agent #13
15 Agent #22
16 Agent #23
17 Group 2 (network 2)
18 Group 3 (network 3)

[Fig. 2]

1 Setting flowchart (part 1) according to the invention
2 Manager (1)
3 Agents
S1 Prepare frame (Echo)
S2 Transmit by broadcast
S3 Receive
S4 Response required?
4 Ignore
S5 Prepare frame (EchoReply)
S6 Transmit
S7 Receive
S8 Register in management table
S9 Prepare frame (SNMP request)
S10 Transmit
S11 Receive
S12 Response required?
S13 Prepare frame (SNMP response)

S14 Transmit
S15 Receive
S16 Register in management table
S17 Complete agent recognition

[Fig. 3]
1 Flowchart for determining priority by manager according to the invention
2 Manager (1)
3 Representative agent
4 Replacement agents
S21 Divide into groups
S22 Determine representative agent for each group
S23 Determine replacement agent for each group
S24 Prepare frame (agent)
S25 Transmit
S26 Receive
S27 Store in monitor table
S28 Transmit to replacement agent
S29 Store in monitor table

[Fig. 4]
1 Flowchart for determining priority by representative agent according to the invention
2 Manager (1)
3 Representative agent
4 Replacement agents
S31 Divide into groups
S32 Determine representative agent for each group
S33 Prepare frame (agent)
S34 Transmit
S35 Receive
S36 Representative agent determines replacement agents and priority
S37 Store in monitor table
S38 Transmit to replacement agents
S39 Store in monitor table

[Fig. 5]
1 Example of frames (part 1) according to the invention

2 Frame (Echo)
3 Destination address
4 Transmitter address
5 Control data
6 Echo: response request data
7 ff: broadcast
Others: unique address
8 Frame (EchoReply)
9 Frame (SNMP request)
10 Protocol data
11 GetRequestPDU: PDU request data
12 Frame (SNMP response)
13 GetResponsePDU: PDU response data
14 Frame (agent)
15 Representative agent
15' Agent data
16 Representative agent
Replacement agents
Priority
Monitor time interval

[Fig. 6]
1 Example of agent management table according to the invention
2 Agent management table (manager 1)
3 Agent address
4 Presence or absence of frame (Echo) response
5 Presence or absence of frame (SNMP) response
6 MIB community name
7 Access right
8 Present

[Fig. 7]
1 Example of monitor table according to the invention
2 Agent
3 Priority
4 Monitor time interval

[Fig. 8]

1 Flowchart for replacing process by frame receipt according to the invention
2 Manager (1)
3 Representative agent
4 Replacement agents
S41 Predetermined time passed?
S42 Prepare and transmit frame (Echo) to each agent
S43 Received within predetermined time?
5 Ignore
S44 Response required?
S45 Prepare and transmit frame (EchoReply)
S46 Received within predetermined time?
S47 Prepare and transmit frame (SNMP request) to each agent
S48 Received within predetermined time?
S49 Response required?
S50 Prepare and transmit frame (SNMP response)
S51 Received within predetermined time?
S52 Recognize as normal
S53 Transmit agent management table to replacement agent
S54 Receive and store management table
S55 Receive and display message and log
S56 Change Echo response to "absent" in agent management table
S57 Change SNMP response to "absent" in agent management table
S58 Notify manager
S60 Switch to representative agent
S61 Update and transmit management table to other members
6 To other members

[Fig. 9]
1 Flowchart for replacing process by polling according to the invention
2 Representative agent
3 Replacement agents
S71 Predetermined time passed?
S72 Prepare frame (SNMP request) addressed to each agent
S73 Transmit to agent higher in priority than local agent
S74 Receive
S75 Prepare frame (SNMP response)
S76 Transmit
S77 Received within predetermined time?

S78 Restored?
S79 Update agent management table
4 Ignore
S80 Transmit to other members
S81 Return to replacement agent
S82 Receive
S83 Return to representative agent
S84 Switch to replacement agent
5 To other members

[Fig. 10]
1 Flowchart of MIB polling according to the invention
2 Manager (1)
3 Agents
S91 Prepare frame (polling)
S92 Transmit
S93 Receive
S94 Polling interval passed?
S95 Prepare frame (MIB request)
4 In same node
S96 Transmit
S97 Received
S98 Prepare frame (MIB response)
S99 Transmit
S100 Receive
S101 MIB value > threshold
S102 Prepare frame (trap)
S103 Transmit
S104 Receive
S105 Display message
S106 Log

[Fig. 11]
1 Example of frame (part 2) according to the invention
2 Frame (polling)
3 Destination address
4 Transmitter address
5 Trap data

6 * MIB name (Ex: total number of transmission data)
* Polling interval
* Threshold
* Trap type

7 Frame (MIB request)

8 Destination address

9 Transmitter address

10 MIB data

11 * MIB community name
* Access right
* MIB name

12 Frame (MIB response)

13 Destination address

14 Transmitter address

15 MIB data

16 MID response data

17 Frame (trap)

18 Destination address

19 Transmitter address

20 Trap data

21 * Trap community name
* Trap type
(Ex: Total number of transmission data exceeds threshold)